Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate 2024

Marking Scheme

Mathematics

Foundation Level

Note to teachers and students on the use of published marking schemes

Marking schemes published by the State Examinations Commission are not intended to be standalone documents. They are an essential resource for examiners who receive training in the correct interpretation and application of the scheme. This training involves, among other things, marking samples of student work and discussing the marks awarded, so as to clarify the correct application of the scheme. The work of examiners is subsequently monitored by Advising Examiners to ensure consistent and accurate application of the marking scheme. This process is overseen by the Chief Examiner, usually assisted by a Chief Advising Examiner. The Chief Examiner is the final authority regarding whether or not the marking scheme has been correctly applied to any piece of candidate work.

Marking schemes are working documents. While a draft marking scheme is prepared in advance of the examination, the scheme is not finalised until examiners have applied it to candidates' work and the feedback from all examiners has been collated and considered in light of the full range of responses of candidates, the overall level of difficulty of the examination and the need to maintain consistency in standards from year to year. This published document contains the finalised scheme, as it was applied to all candidates' work.

In the case of marking schemes that include model solutions or answers, it should be noted that these are not intended to be exhaustive. Variations and alternatives may also be acceptable. Examiners must consider all answers on their merits, and will have consulted with their Advising Examiners when in doubt.

Future Marking Schemes

Assumptions about future marking schemes on the basis of past schemes should be avoided. While the underlying assessment principles remain the same, the details of the marking of a particular type of question may change in the context of the contribution of that question to the overall examination in a given year. The Chief Examiner in any given year has the responsibility to determine how best to ensure the fair and accurate assessment of candidates' work and to ensure consistency in the standard of the assessment from year to year. Accordingly, aspects of the structure, detail and application of the marking scheme for a particular examination are subject to change from one year to the next without notice.

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination 2024

Mathematics

Foundation Level

Marking scheme

300 marks

Structure of the marking scheme

Candidate responses are marked according to different scales, depending on the types of response anticipated. Scales labelled A divide candidate responses into two categories (correct and incorrect). Scales labelled B divide responses into three categories (correct, partially correct, and incorrect), and so on. The scales and the marks that they generate are summarised in this table:

Scale label	B	C	D
No of categories	3	4	5
5-mark scale	0, 3, 5	0, 2, 3, 5	0, 2, 3, 4, 5
10-mark scale	0, 4, 10	0, 3, 5, 10	0, 3, 5, 7, 10
15-mark scale	0, 5, 15	0, 5, 7, 15	0, 3, 5, 7, 15
20 – mark scale			0, 6, 8, 10, 20

A general descriptor of each point on each scale is given below. More specific directions in relation to interpreting the scales in the context of each question are given in the scheme, where necessary.

Marking scales – level descriptors

B-scales (three categories)

- response of no substantial merit (no credit)
- partially correct response (partial credit)
- correct response (full credit)

C-scales (four categories)

- response of no substantial merit (no credit)
- response with some merit (low partial credit)
- almost correct response (high partial credit)
- correct response (full credit)

D-scales (five categories)

- response of no substantial merit (no credit)
- response with some merit (low partial credit)
- response about half-right (mid partial credit)
- almost correct response (high partial credit)
- correct response (full credit)

In certain cases, typically involving incorrect rounding, omission of units, a misreading that does not oversimplify the work, or an arithmetical error that does not oversimplify the work, a mark that is one mark below the full-credit mark may also be awarded. Such cases are denoted with a * and this level of credit is referred to as *Full Credit -1*. Thus, for example, in Scale 10C, *Full Credit -1* of 9 marks may be awarded.

The only marks that may be awarded for a question are those on the scale below, or *Full Credit -1*.

A rounding penalty is applied each time it occurs in the scheme. There is no penalty for omitted units if the question specifies the unit to be used in the answer, and there is generally no penalty for an omitted euro symbol in questions involving money.

In general, accept a candidate's work in one part of a question for use in subsequent parts of the question, unless this oversimplifies the work involved.

Unless otherwise specified, an answer without sufficient supporting work is generally awarded the lowest non-zero level of credit (typically *Partial Credit* or *Low Partial Credit*, as appropriate).

Summary of mark allocations and scales to be applied

<table>
<tr><th colspan="2">Section A (210)
Answer any seven questions</th><th>Section B (90)
Answer any two questions</th></tr>
<tr>
<td>Question 1 (30)
(a)(i)(ii) 15D
(b)(i)(ii) 15D

Question 2 (30)
(a)(i) 10C
(a)(ii) 5B
(b)(i)(ii) 15D

Question 3 (30)
(a) 5B
(b)(i)(ii) 15D
(b)(iii) 5B
(b)(iv) 5B

Question 4 (30)
(a)(i)(ii) 10D
(b)(i)(ii) 5D
(c) 15B</td>
<td>Question 5 (30)
(a)(i) 10C
(a)(ii)(iii) 10D
(a)(iv) 5C
(b) 5B

Question 6 (30)
(a) 10C
(b)(i) 5B
(b)(ii) 10C
(b)(iii) 5B

Question 7 (30)
(a) 5B
(b) 15C
(c) 10B

Question 8 (30)
(a)(i)(ii)(iii) 20D
(b) 10C</td>
<td>Question 9 (45)
(a)(i) 5C
(a)(ii) 5C
(b)(i)(ii) 15D
(c) 10B
(d) 5C
(e) 5C

Question 10 (45)
(a)(i)(ii)(iii) 15D
(b)(i)(ii) 20D
(c)(i)(ii) 10D

Question 11 (45)
(a)(i)(ii)(iii) 15D
(b) 5C
(c)(i)(ii) 5D
(d)(i)(ii)(iii) 20D</td>
</tr>
</table>

Palette of annotations available to examiners

Symbol	Name	Meaning in the body of the work	Meaning when used in the right margin
✓	Tick	Work of relevance	The work presented in the body of the script merits full credit
✗	Cross	Incorrect work (distinct from an error)	The work presented in the body of the script merits 0 credit
*	Star	Rounding / Unit / Arithmetic error Misreading	
~~	Horizontal wavy	Error	
P			The work presented in the body of the script merits partial credit
L			The work presented in the body of the script merits low partial credit
M			The work presented in the body of the script merits mid partial credit
H			The work presented in the body of the script merits high partial credit
F*	F star		The work presented in the body of the script merits Full Credit (– 1)
[	Left Bracket		Another version of this solution is presented elsewhere and it merits equal or higher credit
≀	Vertical wavy	No work on this page (portion of the page)	
o	Oversimplify	The candidate has oversimplified the work	
WOM	Work of Merit	Nothing correct but **Work of Merit** within the body of work	

Note: Where work of substance is presented in the body of the script, the annotation on the right margin should reflect a combination of annotations in the work

In a **C scale** where * and ~~~ and ~~~ appear in the body of the work, then **L** should be placed in the right margin.

In the case of a **D scale** with the same annotations, **M** should be placed in the right margin.

A ✓ in the body of the work may sometimes be used to indicate where a portion of the work presented has value and has merited one of the levels of credit described in the marking scheme. The level of credit is then indicated in the right margin.

Detailed marking notes

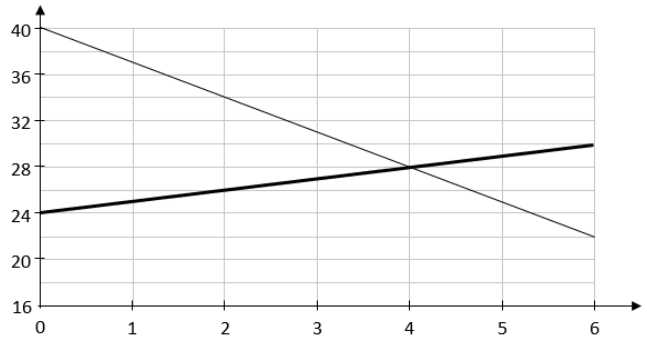
Model Solutions & Marking Notes

Note: The model solutions for each question are not intended to be exhaustive – there may be other correct solutions. Any Examiner unsure of the validity of the approach adopted by a particular candidate to a particular question should contact his / her Advising Examiner.

Q1	Model Solution – 30 Marks	Marking Notes
(a) **(i)** **(ii)**	**(i)** $14 \cdot 50 \times 10 = 145$ **(ii)** $65 \times 2 = 130$ $145 - 130 = [€]15$	**Scale 15D (0, 3, 5, 7, 15)** *Low Partial Credit* • Work of merit in **(i)**, for example, addition or multiplication involving 14.50 • Work of merit in **(ii)**, for example, multiplication by 2 *Mid Partial Credit:* • One part correct • Work of merit in both parts *High Partial Credit:* • One part correct and work of merit in the other part
(b) **(i)** **(ii)**	**(i)** $\frac{40}{80}$ $= 0 \cdot 5$ [hours] or 30 mins **(ii)** $\frac{190}{2}$ $= 95$ [km/hour]	**Scale 15D (0, 3, 5, 7, 15)** *Low Partial Credit* • Work of merit in **(i)** or **(ii)**, for example, a relevant formula *Mid Partial Credit:* • One part correct • Work of merit in both parts *High Partial Correct* • One part correct and work of merit in the other part

Q2	Model Solution – 30 Marks	Marking Notes
(a) **(i)**	<table><tr><td>BH</td><td>BT</td></tr><tr><td>YH</td><td>YT</td></tr><tr><td>RH</td><td>RT</td></tr><tr><td>PH</td><td>PT</td></tr></table>	**Scale 10C (0, 3, 5, 10)** *Low Partial Credit:* • 1 to 3 correct outcomes *High Partial Credit:* • 4 or 5 correct outcomes
(a) **(ii)**	$\frac{1}{8}$ or $0 \cdot 125$ or $12 \cdot 5[\%]$	**Scale 5B (0, 3, 5)** *Partial Credit:* • Number of favourable outcomes correct • Total number of outcomes correct
(b) **(i)** **(ii)**	**(i)** $360 - (180 + 54 + 48) = 78[^\circ]$ $[360 - 282 = 78^\circ]$ **(ii)** $\frac{48}{180} \times 30 = 8$ **OR** $180 \div 30 = 6$ $48 \div 6 = 8$ **OR** $60 \times \frac{48}{360} = 8$	**Scale 15D (0, 3, 5, 7, 15)** *Low Partial Credit* • Work of merit in **(i)**, for example, writes 360° or any attempt at adding given angles • Work of merit in **(ii)**, for example, 60 written *Mid Partial Credit:* • One part correct • Work of merit in both parts *High Partial Credit:* • One part correct and work of merit in the other part

<table>
<tr><th>Q3</th><th>Model Solution – 30 Marks</th><th>Marking Notes</th></tr>
<tr><td>(a)</td><td>$[€]34\,000$</td><td>Scale 5B (0, 3, 5)

Partial Credit:
• Relevant indication on graph</td></tr>
<tr><td>(b)
(i)
(ii)</td><td>(i)
<table><tr><td>t</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>V</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td></tr></table>
(ii)
  </td><td>Scale 15D (0, 3, 5, 7, 15)

Low Partial Credit
• Work of merit in (i), for example, 1 correct entry in table
• Work of merit in (ii), for example, 1 point correctly graphed ($t \neq 4$)

Mid Partial Credit:
• One part correct
• Work of merit in both parts

High Partial Credit:
• One part correct and work of merit in the other part</td></tr>
<tr><td>(b)
(iii)</td><td>$t = 4$ [years]</td><td>Scale 5B (0, 3, 5)

Partial Credit:
• Relevant indication on graph
• 28000

Full Credit -1:
• 2022
• No work shown on graph</td></tr>
<tr><td>(b)
(iv)</td><td>$V = 24 + t$

24 is the value at $t = 0$ and the value goes up by $[€]1000$ each year

OR

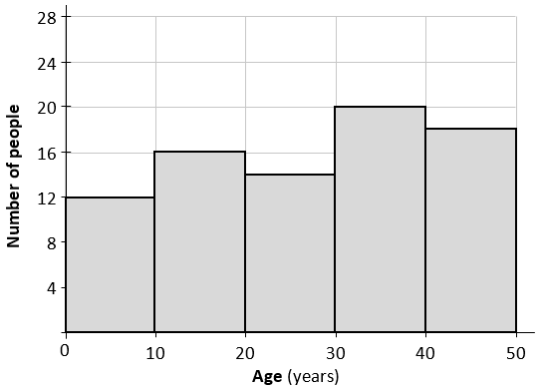
Shows formula works for 2 values

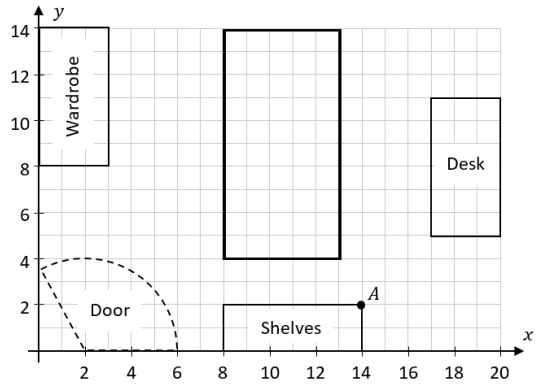
OR

Other valid reason</td><td>Scale 5B (0, 3, 5)

Partial Credit:
• Correct answer with no or incorrect reason
• Incorrect answer with work of merit in reason given</td></tr>
</table>

Q4	Model Solution – 30 Marks	Marking Notes
(a) **(i)** **(ii)**	**(i)** $\frac{6}{11}$ **(ii)** $11-(3+2)=6$	**Scale 10D (0, 3, 5, 7, 10)** *Low Partial Credit* • Work of merit in **(i)**, for example, correct number of total or favourable outcomes • Work of merit in **(ii)**, for example, relevant addition or subtraction *Mid Partial Credit:* • One part correct • Work of merit in both parts *High Partial Credit:* • One part correct and work of merit in the other part
(b) **(i)** **(ii)**	**(i)** 17 **(ii)** $\frac{15+16+17+14+17+17}{6}$ $\frac{96}{6}=16$	**Scale 5D (0, 2, 3, 4, 5)** *Low Partial Credit* • Work of merit in **(i)**, for example, reference to most common • Work of merit in **(ii)**, for example, relevant addition or 6 written *Mid Partial Credit:* • One part correct • Work of merit in both parts • Mode and mean correct and reversed without relevant work *High Partial Credit:* • One part correct and work of merit in the other part • Mode and mean correct and reversed with some relevant work
(c)	No The numbers are not ranked **OR** The median is 16	**Scale 15B (0, 5, 15)** *Partial Credit:* • Correct answer with invalid or no reason • Work of merit in reason, for example, mentions middle number

Q5	Model Solution – 30 Marks	Marking Notes
(a) **(i)**		**Scale 10C (0, 3, 5, 10)** *Low Partial Credit:* • One correct interval graphed *High Partial Credit:* • Two or three correct intervals graphed
(a) **(ii)** **(iii)**	**(ii)** $12 + 16 + 14 + 20 + 18 = 80$ **(iii)** $12 + 16 = 28$	**Scale 10D (0, 3, 5, 7, 10)** *Low Partial Credit* • Work of merit in **(i)**, for example, relevant addition • Work of merit in **(ii)**, for example, relevant addition or 12 or 16 written *Mid Partial Credit:* • One part correct • Work of merit in both parts *High Partial Credit:* • One part correct and work of merit in the other part
(a) **(iv)**	$\frac{20 + 18}{80} \times 100 = 47 \cdot 5[\%]$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • 20+18 • Use of 80 • Some correct work with percentages *High Partial Credit:* • 0.475 • $\frac{20+18}{80} \times 100$ and stops
(b)	$7{:}30 + 1{:}45 = 9{:}15$ [pm]	**Scale 5B (0, 3, 5)** *Partial Credit:* • Any attempt at adding the relevant times

Q6	Model Solution – 30 Marks	Marking Notes
(a)	$4 \times 2 \cdot 8 = 11 \cdot 2$ [m^2]	**Scale 10C (0, 3, 5, 10)** Accept correct answer without units *Low Partial Credit:* • Correct formula written *High Partial Credit:* • $4 \times 2 \cdot 8$ and stops
(b) **(i)**	$A = (14, 2)$	**Scale 5B (0, 3, 5)** *Partial Credit:* • 14 or 2 written *Full Credit -1:* • Answer given as (2, 14)
(b) **(ii)**	 Or similar position	**Scale 10C (0, 3, 5, 10)** *Low Partial Credit:* • Effort at drawing any rectangle *High Partial Credit:* • Rectangle constructed with two correct sides, that is, 5 units or 10 units
(b) **(iii)**	6 units $= 120$ [cm]	**Scale 5B (0, 3, 5)** Accept correct answer without units *Partial Credit:* • Indicates multiplication by 20

<table>
<tr><th>Q7</th><th>Model Solution – 30 Marks</th><th>Marking Notes</th></tr>
<tr><td>(a)</td><td>$4 \times 3 \times 2 = 24$</td><td>Scale 5B (0, 3, 5)

Partial Credit:
• Multiplies 2 relevant figures
• Writes a possible combination</td></tr>
<tr><td>(b)</td><td>$\frac{4}{3}\pi(3 \cdot 5)^3$

$= 179 \cdot 594 \ldots$

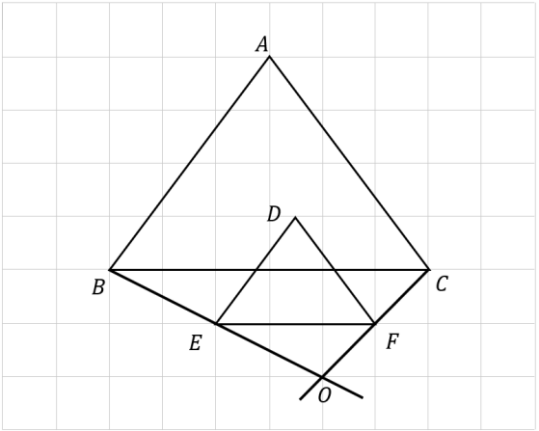
$= 180$ [cm^3]</td><td>Scale 15C (0, 5, 7, 15)

Low Partial Credit:
• Work of merit, for example, $\frac{4}{3}\pi r^3$

High Partial Credit:
• Fully correct substitution into formula

Full Credit -1
• Apply a * for no or incorrect rounding</td></tr>
<tr><td>(c)</td><td><table><tr><td>Axial symmetry in the x - axis</td><td>Y</td></tr><tr><td>Rotation through $90°$ about the point $(0, 0)$</td><td>Z</td></tr><tr><td>Central symmetry through the point $(0, 0)$</td><td>X</td></tr></table></td><td>Scale 10B (0, 4, 10)

Partial Credit:
• One or two correct entries</td></tr>
</table>

Q8	Model Solution – 30 Marks	Marking Notes
(a) **(i)** **(ii)** **(iii)**	**(i)** $\|BC\| = 6$ [cm] $\|EF\| = 3$ [cm] **(ii)** $6 \div 3 = 2$ **(iii)**  	**Scale 20D (0, 6, 8, 10, 20)** *Low Partial Credit:* • Work of merit in one part **only**, for example, one correct length in **(i)** or $3 \div 6$ in **(ii)**, or relevant line constructed in **(iii)** *Mid Partial Credit:* • One part correct • Work of merit in two parts **only** *High Partial Credit:* • Two parts correct • Work of merit in three parts *Full Credit-1:* • Scale factor given as $\frac{1}{2}$ or similar
(b)	$\frac{1}{2}(6) \times 4 = 12$ cm^2	**Scale 10C (0, 3, 5, 10)** *Low Partial Credit:* • Correct Formula *High Partial Credit:* • Correct formula fully substituted • $\mathbf{6 \times 4 = 24}$ *Full Credit -1* • Apply a * for no units

Q9	Model Solution – 45 Marks	Marking Notes
(a) **(i)**	$2(54 + 72) = 252$ [cm]	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Any indication of relevant addition *High Partial Credit:* • $54 + 72 = 126$
(a) **(ii)**	$h^2 = 54^2 + 72^2$ $h^2 = 8100$ $h = 90$ [cm]	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Correct Formula • Any correct substitution into formula *High Partial Credit:* • Fully correct substitution into formula
(b) **(i)** **(ii)**	**(i)** 45 [cm] **(ii)** $\pi(45)^2 = 6361.725 \ldots$ $= 6362$ [cm²]	**Scale 15D (0, 3, 5, 7, 15)** *Low Partial Credit* • Work of merit in **(i)**, for example, division by 2 • Work of merit in **(ii)**, for example, relevant formula *Mid Partial Credit:* • One part correct • Work of merit in both parts *High Partial Credit:* • One part correct and work of merit in the other part
(c)	$20 \div 1.07 = 18.691 \ldots = [€]18.69$	**Scale 10B (0, 4, 10)** *Partial Credit:* • $\mathbf{20 \times 1.07}$

Q9	Model Solution – 45 Marks	Marking Notes
(d)	$\frac{1}{8} + 15.3\% + 0 \cdot 162 = 44[\%]$	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Work of merit, for example, one correct conversion or indicates addition of two relevant numbers *High Partial Credit* • All three numbers written as either fractions, decimals or percentages *Full Credit -1:* • Answer given as 0.44 or $\frac{11}{25}$
(e)	$24 \times 6 = 144$ $500 \div 144 = 3 \cdot 47 \ldots$ $= 3 \cdot 5$ [hours] **OR** $500 \div 24 = 20 \cdot 8\dot{3}$ $20 \cdot 8\dot{3} \div 6 = 3 \cdot 47 \ldots$ $= 3 \cdot 5$ [hours]	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Relevant multiplication or division indicated • One new relevant ratio, for example, 144 in one hour or 2.4 in 1 minute *High Partial Credit:* • Two or more new relevant ratios • $20 \cdot 8\dot{3}$ *Full Credit -1:* • Apply a * for not in hours, or no or incorrect rounding, or both, for example 208 minutes or similar

Q10	Model Solution – 45 Marks	Marking Notes
(a) **(i)** **(ii)** **(iii)**	**(i)** $14 \times 8 = [€]112$ **(ii)** $14 \times 1 \cdot 5 = [€]21$ **(iii)** $(4 \times 112) + (6 \times 21) = [€]574$	**Scale 15D (0, 3, 5, 7, 15)** *Low Partial Credit:* • Work of merit in one part **only**, for example, relevant addition or multiplication in **(i)**, **(ii)** or **(iii)** *Mid Partial Credit:* • One part correct • Work of merit in two parts **only** *High Partial Credit:* • Two parts correct • Work of merit in three parts
(b) **(i)** **(ii)**	**(i)** Gross Tax: $609 \times 0 \cdot 2 = 121.80$ **(ii)** Net Tax: $121.80 - 68.27 = 53.53$ Net Pay: $609 - 53.53 = [€]555.47$	**Scale 20D (0, 6, 8, 10, 20)** *Low Partial Credit* • Work of merit in **(i)**, for example, 0.2 • Work of merit in **(ii)**, for example, some relevant addition or subtraction *Mid Partial Credit:* • One part correct • Work of merit in both parts *High Partial Credit:* • One part correct and work of merit in the other part

Q10	Model Solution – 45 Marks	Marking Notes
(c) **(i)** **(ii)**	**(i)** $11 + 19 + 6 = [€]36$ **(ii)** $36 \times 0 \cdot 15 = [€]5.40$	**Scale 10D (0, 3, 5, 7, 10)** *Low Partial Credit* • Work of merit in **(i)**, for example, some relevant addition • Work of merit in **(ii)**, for example, 0.15 *Mid Partial Credit:* • One part correct • Work of merit in both parts *High Partial Credit:* • One part correct and work of merit in the other part

Q11	Model Solution – 45 Marks	Marking Notes
(a) **(i)** **(ii)** **(iii)**	**(i)** $1, 2, 3, 6$ **(ii)** $27, 54$ **(iii)** 6859	**Scale 15D (0, 3, 5, 7, 15)** Note: **Accept 54 and 81** as correct in **(ii)** *Low Partial Credit:* • Work of merit in one part **only**, for example, one correct factor in **(i)**, one correct multiple in **(ii)** or 19 x 19 written in **(iii)** *Mid Partial Credit:* • One part correct • Work of merit in two parts **only** *High Partial Credit:* • Two parts correct • Work of merit in three parts
(b)	$17 - (-19) = 36$ $36 \div 9 = 4$ [hours] **OR** $17 - 9 = 8$ $8 - 9 = -1$ $-1 - 9 = -10$ $-10 - 9 = -19$ = 4 [hours]	**Scale 5C (0, 2, 3, 5)** *Low Partial Credit:* • Work of merit, for example, some multiple of -9 or any attempt at subtracting 9 from 17 or adding 9 to -19 *High Partial Credit:* • Finds temperature difference of 36 • Repeatedly subtracts 9 from 17 or adds 9 to -19

<table>
<tr><th>Q11</th><th>Model Solution – 45 Marks</th><th>Marking Notes</th></tr>
<tr><td>(c)
(i)
(ii)</td><td>(i)
$2G + 5B$
(ii)
Aaron
Aaron: $3(7) + 2(2) = 25$
Tom: $2(7) + 5(2) = 24$</td><td>Scale 5D (0, 2, 3, 4, 5)
Low Partial Credit
• Work of merit in (i), for example, 2G or 5B only
• Work of merit in (ii), for example, some relevant addition or multiplication
Mid Partial Credit:
• One part correct
• Work of merit in both parts
High Partial Credit:
• One part correct and work of merit in the other part</td></tr>
<tr><td>(d)
(i)
(ii)
(iii)</td><td>(i)
<table><tr><td>Opposite</td><td>4</td></tr><tr><td>Adjacent</td><td>16</td></tr></table>(ii)
$\tan X = \frac{4}{16}$
(iii)
$X = \tan^{-1}\left(\frac{4}{16}\right) = 14.036\ldots. = 14[°]$</td><td>Scale 20D (0, 6, 8, 10, 20)
Low Partial Credit:
• Work of merit in one part only, for example, 4 or 16 correct in (i), $\tan^{-1}$ written in (iii)
Mid Partial Credit:
• One part correct
• Work of merit in two parts only
High Partial Credit:
• Two parts correct</td></tr>
</table>